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Uniporous pegs associated with sensilla auricillica on the antennae of Noctuidae (Lepidoptera)

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Summary

Uniporous pegs are described on the antennae of some Noctuidae subfamilies. They seem peculiar to this family. They are present in both males and females on each lateral face of the flagellar segments and number from 1-4 sensilla per segment. The general pattern of the number and distribution of these sensilla is similar in all 4 species studied. The terminal pore suggests a contact chemoreceptive role. The association between uniporous pegs and sensilla auricillica in pits may have a biological significance which is emphasized.

Résumé

Des sensilles à pore unique sont décrites sur l'antenne de quelques sous-familles de Noctuidae. Elles semblent particulières à cette famille. Elles sont présentes chez les mâles et les femelles sur chaque face latérale des segments flagellaires, au nombre de 1-4 sensilles par segment. Le nombre et la distribution de ces sensilles sont semblables chez les 4 espèces étudiées. Le pore terminal suggère une fonction chimioréceptive de contact. L'association entre les sensilles à pore unique et les sensilles auricilliformes dans des cavités peut avoir une signification biologique qui est envisagée.

Introduction

Short sensilla with a terminal pore were described for the first time on the antennae of the Noctuidae Noctuinae *Noctua pronuba* L. (Faucheux, 1990). Similar sensilla, but deprived of any pore, have been observed in the Noctuinae *Scoliopteryx libatrix* L. (Subchev, 1980), the Hadeninae *Mamestra brassicae* L. (Subchev & Stanimirova, 1980) and *Pseudaletia unipuncta* (Haw.) (Lavoie-Dornik & McNeil, 1987). All these authors considered these pegs as nonporous. However, the micrographs of these sensilla are not very clear and therefore do not prove that pores are absent. The present paper attempts to discover the presence of uniporous pegs in some other Noctuidae by means of scanning electron microscopy.

Methods

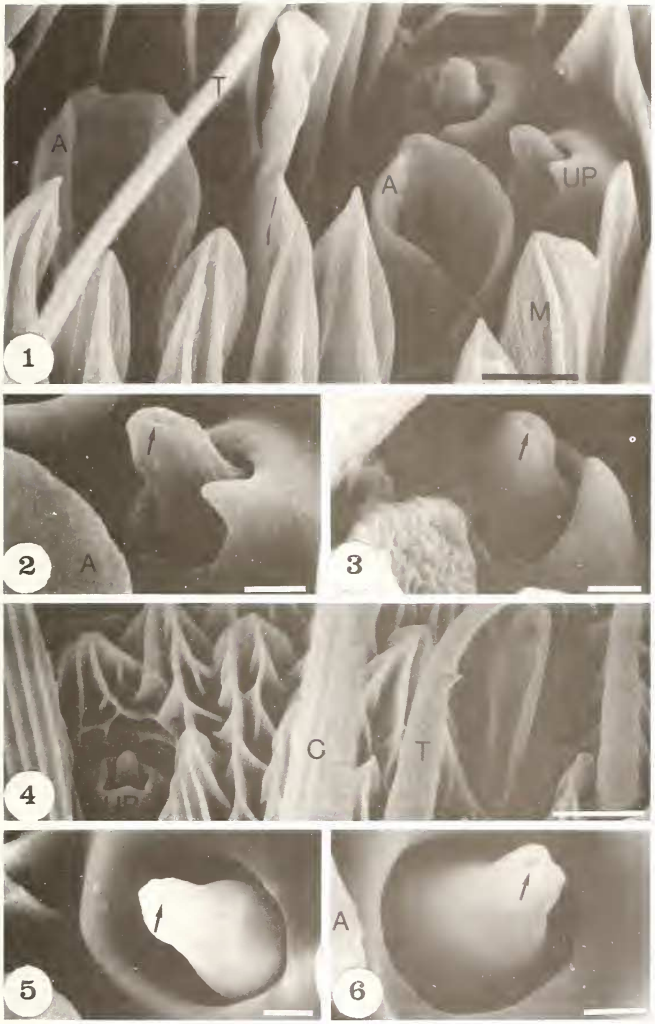
To examine the types of sensilla, the antennae were soaked for 3 hrs in 3% glutaraldehyde, then post-fixed for 2 hrs in osmium tetroxide in a Palade buffer. The specimens were then dried in a critical point dryer. Ten antennae of each species and each sex were examined in a Jeol J.S.M. 6400 F SEM at 7 kV. The pore diameter was measured directly from SEM micrographs at 30,000 magnification. Further studies were conducted with a light microscope by using the crystal violet method (Slifer, 1960) and the reduced silver nitrate technique (Schafer & Sanchez, 1976) to detect the permeable sensilla.

Results

The antennae of both sexes of four species belonging to four different subfamilies are studied : *Mythimna impura* Hb. (Hadeninae), *Acronicta psi* (L.) (Apatelinae), *Noctua janthina* D.& S. (Noctuinae), and *Autographa gamma* (L.) (Plusiinae). In *M. impura*, the uniporous sensillum comprises a short basal socket and a stout apical peg (UP, Fig. 1). The socket bears 1-3 peaks at the distal end. The peg is 2.5 µm long (range 2.3-2.7) with a diameter of 1.3 µm at midlength and of 1.9 µm at the base. In all the sensilla observed (n=73), the peg possesses a terminal pore (Figs 2, 3). The diameter of the pore varies from 60 nm to 90 nm (mean = 73 ± 5.4). The pore is also identified when coloured with the crystal violet method after Slifer (1960) and the reduced silver nitrate technique of Schafer & Sanchez (1976). Consequently, these pegs are uniporous sensilla (UP) according to Zacharuk (1985). The peg of *A. gamma*, 1.7 µm long, is also surrounded by a socket (Fig. 4) and its pore measures 85 nm ± 4.9 in diameter (n = 31). In *A. psi* (Fig. 5) and *N. janthina* (Fig. 6), the peg is deprived of a socket, but is inserted in a circular pit ; the pore reaches a mean diameter of 110 nm ± 7.8 in *A. psi* (n = 85) and 130 nm ± 8.2 in *N. janthina* (n = 56).

In the 4 species, the UP are located in a deep pit on the distal edge and on each lateral face of flagellar segments, between the unscaled ventral face and the scaled dorsal face. There are one or, more usually, two pits per lateral face. These pits are located side by side across the segment, the more dorsal often being a little beneath the more ventral ones.

Except in the case of *A. gamma*, each pit usually also contains sensilla auricillica (A, Fig. 1). These sensilla are buttressed, horseshoe-shaped and multiporous and therefore classified as "multiporous chemosensilla



Figs 1-6. 1. Sensilla auricillica (A) and uniporous pegs (UP) of *Mythimna impura*, bar = 3 µm ; 2-3. Detail of uniporous pegs of *M. impura*, bar = 1 µm ; 4. Sensillum auricillicum (A) and uniporous peg (UP) of *Autographa gamma*, bar = 5 µm. 5. Uniporous peg of *Acronicta psi*, bar = 1 µm ; 6. Uniporous peg of *Noctua janthina*, bar = 1 µm.
C. sensillum chaeticum ; M. microtrichia ; T. sensillum trichodeum. Arrows indicate the terminal pore.

with a pitted surface" (MPP) following Zacharuk (1985). In the 3 species, each pit may contain one of the following associations : 1 UP + 2 MPP (63%), 1 UP + 1 MPP (8%), 2 UP + 1 MPP (11%), or simply 1 MPP (9%), 2 MPP(6%), 1 UP (3%). The distribution of the different associations along the antenna is irregular. There are no significant differences between males and females in the morphology, numbers and distribution of the UP pegs. In *A. gamma*, the sensilla auricillica are rabbit-ear-shaped and neither located in a pit nor associated with UP pegs (Fig. 4).

Discussion

In *N. pronuba* (Faucheux, 1990), the antennae of the 4 studied specimens possess short pegs which reveal the following characteristics : 1 — with a terminal pore ; 2 — generally associated with sensilla auricillica ; 3 — located in a deep pit ; 4 — present in small numbers : 0-4/segment ; 5 — present in both sexes. These uniporous pegs have not yet been described in other families of Lepidoptera. The presence of a terminal pore suggests a contact chemoreceptive role (Zacharuk, 1985).

The sensilla auricillica of the majority of Lepidoptera are rabbit-ear-shaped and not located in a pit. In Noctuidae, they are both buttressed and located in a pit (Flower & Helson, 1974 ; Hallberg, 1981 ; Faucheux, 1990). It is also in this family that they are often associated with uniporous pegs. There are however exceptions, for instance in *A. gamma*, which could be of phylogenetic interest. A more complete study of different subfamilies of Noctuidae would no doubt provide further precisions. The "MPP+UP" association in a common pit may have biological significance. The sensilla auricillica are frequently compared to flattened sensilla basiconica and, like these structures, thought to be sensitive to foodplant odours (Wall, 1978). In most Lepidoptera, they are hidden by scales and are therefore likely to be stimulated by the odours trapped between scales and antennal cuticle. As a result, in Noctuidae, their localisation, near the scales and in a deep pit, allows them to be stimulated by the odours concentrated in the pits. Their horseshoe-shape allows the scent molecules to penetrate through all the pores. The uniporous pegs may benefit from this situation. Indeed, if a secretion emitted by, for instance plants or flowers, is retained in the pits, it may stimulate both the UP pegs, by contact, and the MPP, by olfaction. An ultrastructural and electrophysiological study would be required to confirm this hypothesis.

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